

Application Number 10/825,955
Amendment response to Office Action mailed July 20, 2006

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

Claim 1 (Currently Amended): A method comprising:

monitoring a plurality of physiological parameters of a patient via a medical device, wherein the plurality of physiological parameters includes at least one parameter indicative of patient physical activity;

determining when the patient is attempting to sleep;

determining values of at least one sleep quality metric that is indicative of sleep quality based on at least one of the physiological parameters and a determination that the patient is attempting to sleep;

periodically determining an activity level of the patient based on at least one of the physiological parameters and a determination that the patient is not attempting to sleep; and

determining a value of at least one activity metric based on the determined activity level.

Claim 2 (Original): The method of claim 1, wherein determining when the patient is attempting to sleep comprises receiving an indication from the patient that the patient is attempting to sleep.

Claim 3 (Original): The method of claim 1, wherein monitoring a plurality of physiological parameters comprising monitoring at least one signal that indicates posture of the patient, and determining when the patient is attempting to sleep comprises determining when the patient is recumbent.

Claim 4 (Original): The method of claim 3, wherein monitoring at least one signal comprises monitoring a signal from each of a plurality of orthogonally aligned accelerometers, and determining when the patient is recumbent comprises determining when the patient is recumbent based on a DC component of each of the signals.

Application Number 10/825,955
Amendment response to Office Action mailed July 20, 2006

Claim 5 (Original): The method of claim 1, wherein determining when the patient is attempting to sleep comprises determining when the patient is attempting to sleep based on a physical activity level of the patient.

Claim 6 (Original): The method of claim 5, wherein determining when the patient is attempting to sleep based on activity level comprises:

- comparing the activity level to an activity level threshold; and
- comparing an amount of time that the activity level remains substantially below the activity level threshold to a time threshold.

Claim 7 (Withdrawn): The method of claim 1, wherein monitoring a plurality of physiological parameters comprising monitoring a level of melatonin within a bodily fluid, and determining when the patient is attempting to sleep comprises determining when the patient is attempting to sleep based on the melatonin level.

Claim 8 (Currently Amended): The method of claim 1, wherein monitoring a plurality of physiological parameters comprises monitoring at least one of posture, heart rate, respiration rate, respiratory volume, and or core temperature.

Claim 9 (Currently Amended): The method of claim 1, wherein monitoring a plurality of physiological parameters comprises monitoring at least one of blood pressure, blood oxygen saturation, partial pressure of oxygen within blood, partial pressure of oxygen within cerebrospinal fluid, muscular activity, arterial blood flow, and or galvanic skin response.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 10 (Withdrawn): The method of claim 1, wherein the sleep quality metric comprises sleep efficiency, and determining values of the sleep quality metric comprises:

determining when the patient is asleep based on at least one of the physiological parameters; and

determining a percentage of time that the patient is asleep while the patient is attempting to sleep.

Claim 11 (Original): The method of claim 1, wherein the sleep quality metric comprises sleep latency, and determining values of the sleep quality metric comprises:

identifying a first time when the patient is attempting to fall asleep;

identifying a second time when the patient falls asleep based on at least one of the physiological parameters; and

determining an amount of time between the first and second times.

Claim 12 (Original): The method of claim 1, wherein determining values of the sleep quality metric comprises:

identifying when the patient is asleep based on at least one of the physiological parameters; and

determining an amount of time that the patient is asleep during a period.

Claim 13 (Withdrawn): The method of claim 1, wherein determining values of the sleep quality metric comprises:

identifying when the patient is asleep based on at least one of the physiological parameters; and

identifying at least one of a number of arousal events and a number of apnea events during a period of sleep.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 14 (Original): The method of claim 1, wherein determining values of the sleep quality metric comprises:

identifying when the patient is within a sleep state based on at least one of the physiological parameters; and

determining an amount of time that the patient was within the sleep state.

Claim 15 (Original): The method of claim 14, wherein the sleep state comprises at least one of an S3 sleep state and an S4 sleep state.

Claim 16 (Cancelled).

Claim 17 (Currently Amended): The method of claim ~~15~~ 1, wherein determining a value of an activity metric comprises determining at least one of a mean and a median of determined activity levels.

Claim 18 (Original): The method of claim 17, wherein determining a value of an activity metric comprises:

comparing the at least one of the mean and the median activity level to at least one threshold; and

selecting the activity metric value from a plurality of predetermined possible activity metric values based on the comparison.

Claim 19 (Currently Amended): The method of claim ~~15~~ 1, wherein determining a value of an activity metric comprises:

comparing each of the activity levels to a threshold value; and

determining at least one of a percentage of time above the threshold and a percentage of time below the threshold.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 20 (Currently Amended): The method of claim 15 1, wherein determining a value of an activity metric comprises:

- comparing each of the activity levels to a threshold value; and
- determining an average length of time that consecutively determined activity levels were above the threshold.

Claim 21 (Original): The method of claim 1, wherein periodically determining an activity level comprises periodically determining a number of activity counts.

Claim 22 (Original): The method of claim 1, wherein the medical device delivers a therapy to the patient according to a plurality of therapy parameter sets, the method further comprising:

- associating each of the determined sleep quality metric values and each of the determined activity levels with a current therapy parameter set;

- for each of the plurality of therapy parameter sets, determining a representative value of each of the at least one sleep quality metric based on the sleep quality metric values associated with the therapy parameter set; and

- for each of the plurality of therapy parameter sets, determining at least one activity metric value based on the activity levels associated with the therapy parameter set.

Claim 23 (Original): The method of claim 22, further comprising presenting a list of the therapy parameter sets, associated representative sleep quality metric values, and associated activity metric values.

Claim 24 (Original): The method of claim 23, further comprising ordering the list of therapy parameter sets according to values of a user selected one of the sleep quality metrics and activity metrics.

Claim 25 (Original): The method of claim 1, wherein the medical device comprises an implantable medical device.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 26 (Previously Presented): The method of claim 25, wherein the implantable medical device comprises at least one of an implantable neurostimulator and an implantable drug pump.

Claim 27 (Original): The method of claim 1, wherein the medical device comprises at least one of a trial neurostimulator and a trial pump.

Claim 28 (Withdrawn): A medical system comprising:

a medical device that monitors a plurality of physiological parameters of a patient, wherein the plurality of physiological parameters includes at least one physiological parameter indicative of patient physical activity; and

a processor that determines when the patient is attempting to sleep, determines values of at least one metric that is indicative of sleep quality based on at least one of the physiological parameters and a determination that the patient is attempting to sleep, periodically determines an activity level of the patient based on at least one of the physiological parameters and a determination that the patient is not attempting to sleep, and determines a value of at least one activity metric based on the determined activity levels.

Claim 29 (Withdrawn): The medical system of claim 28, wherein the processor receives an indication from the patient that the patient is attempting to sleep.

Claim 30 (Withdrawn): The medical system of claim 28, wherein the medical device monitors at least one signal that indicates posture of the patient, and the processor determines when the patient is attempting to sleep by determining when the patient is recumbent.

Claim 31 (Withdrawn): The medical system of claim 30, further comprising a plurality of orthogonally aligned accelerometers, wherein the medical device monitors a signal from each of a plurality of orthogonally aligned accelerometers, and the processor determines when the patient is recumbent based on a DC component of each of the signals.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 32 (Withdrawn): The medical system of claim 28, wherein the processor determines when the patient is attempting to sleep based on a physical activity level of the patient.

Claim 33 (Withdrawn): The medical system of claim 32, wherein the processor compares the activity level to an activity level threshold, and compares an amount of time that the activity level remains substantially below the activity level threshold to a time threshold to determine when the patient is attempting to sleep.

Claim 34 (Withdrawn): The medical system of claim 28, wherein the medical device monitors at least one signal that indicates a level of melatonin within a bodily fluid of the patient, and the processor determines when the patient is attempting to sleep based on the melatonin level.

Claim 35 (Withdrawn): The medical system of claim 28, wherein the medical device monitors at least one of posture, heart rate, respiration rate, respiratory volume, and core temperature.

Claim 36 (Withdrawn): The medical system of claim 28, wherein the medical device monitors at least one of blood pressure, blood oxygen saturation, partial pressure of oxygen within blood, partial pressure of oxygen within cerebrospinal fluid, muscular activity, arterial blood flow, and galvanic skin response.

Claim 37 (Withdrawn): The medical system of claim 28, wherein the sleep quality metric comprises sleep efficiency, and the processor determines when the patient is asleep based on at least one of the physiological parameters, and determines a percentage of time that the patient is asleep while the patient is attempting to sleep as a value of the sleep quality metric.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 38 (Withdrawn): The medical system of claim 28, wherein the sleep quality metric comprises sleep latency, and the processor identifies a first time when the patient is attempting to fall asleep, identifies a second time when the patient falls asleep based on at least one of the physiological parameters, and determines an amount of time between the first and second times as a value of the sleep quality metric.

Claim 39 (Withdrawn): The medical system of claim 28, wherein the processor identifies when the patient is asleep based on at least one of the physiological parameters, and determines an amount of time that the patient is asleep during a period as a value of the sleep quality metric.

Claim 40 (Withdrawn): The medical system of claim 28, wherein the processor identifies when the patient is asleep based on at least one of the physiological parameters, and identifies at least one of a number of arousal events and a number of apnea events during a period of sleep as a value of the sleep quality metric.

Claim 41 (Withdrawn): The medical system of claim 28, wherein the processor identifies when the patient is within a sleep state based on at least one of the physiological parameters, and determines an amount of time that the patient was within the sleep state as a value of the sleep quality metric.

Claim 42 (Withdrawn): The medical system of claim 41, wherein the sleep state comprises at least one of an S3 sleep state and an S4 sleep state.

Claim 43 (Canceled)

Claim 44 (Original): The medical system of claim 43, wherein the processor determines an activity metric value as at least one of a mean and a median of determined activity levels.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 45 (Withdrawn): The medical system of claim 43, wherein the processor compares the at least one of a mean and a median activity level to at least one threshold, and selects the activity metric value from a plurality of predetermined possible activity metric values based on the comparison.

Claim 46 (Withdrawn): The medical system of claim 43, wherein the processor compares each of the activity levels to a threshold value, and determines at least one of a percentage of time above the threshold and a percentage of time below the threshold as an activity metric value.

Claim 47 (Withdrawn): The medical system of claim 43, wherein the processor compares each of the activity levels to a threshold value, and determines an average length of time that consecutively determined activity levels were above the threshold as an activity metric value.

Claim 48 (Withdrawn): The medical system of claim 28, wherein the processor periodically determines an activity level by periodically determining a number of activity counts.

Claim 49 (Withdrawn): The medical system of claim 28,
wherein the medical device delivers a therapy to the patient according to a plurality of therapy parameter sets,
wherein the processor associates each of the determined sleep quality metric value and each of the determined activity levels with a current therapy parameter set,
wherein, for each of the plurality of therapy parameter sets, the processor determines a representative value of each of the at least one sleep quality metric based on the sleep quality metric values associated with the therapy parameter set, and
wherein, for each of the plurality of therapy parameter sets, the processor determines at least one activity metric value based on the activity levels associated with the therapy parameter set.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 50 (Withdrawn): The medical system of claim 49, further comprising a programming device including a display that presents a list of the therapy parameter sets, associated representative sleep quality metric values, and associated activity metric values.

Claim 51 (Withdrawn): The medical system of claim 50, wherein the programming device receives user selection of one of the sleep quality metrics and activity metric, and orders the list of therapy parameter sets according to values of the user selected one of the sleep quality metrics and activity metrics.

Claim 52 (Withdrawn): The medical system of claim 28, wherein the processor comprises a processor of the medical device.

Claim 53 (Withdrawn): The medical system of claim 28, further comprising a programming device, wherein the processor comprises a processor of the programming device.

Claim 54 (Withdrawn): The medical system of claim 28, wherein the medical device comprises an implantable medical device.

Claim 55 (Withdrawn): The medical system of claim 54, wherein the implantable medical device comprises at least one of an implantable neurostimulator and an implantable drug pump.

Claim 56 (Withdrawn): The medical system of claim 28, wherein the medical device comprises at least one of a trial neurostimulator and a trial pump.

Claim 57 (Withdrawn): A medical system comprising:

means for monitoring a plurality of physiological parameters of a patient via a medical device, wherein the plurality of physiological parameters includes at least one parameter indicative of patient physical activity;

means for determining when the patient is attempting to sleep;

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

means for determining values of at least one metric that is indicative of sleep quality based on at least one of the physiological parameters and a determination that the patient is attempting to sleep;

means for periodically determining an activity level of the patient based on at least one of the physiological parameters and a determination that the patient is not attempting to sleep; and

means for determining a value of at least one activity metric based on the determined activity levels.

Claim 58 (Withdrawn): The medical system of claim 57, wherein means for determining when the patient is attempting to sleep comprises means for receiving an indication from the patient that the patient is attempting to sleep.

Claim 59 (Withdrawn): The medical system of claim 57,
wherein means for monitoring a plurality of physiological parameters comprises means monitoring at least one signal that indicates posture of the patient, and
wherein means for determining when the patient is attempting to sleep comprises means for determining when the patient is recumbent.

Claim 60 (Withdrawn): The medical system of claim 57, wherein means for determining when the patient is attempting to sleep comprises means for determining when the patient is attempting to sleep based on a physical activity level of the patient.

Claim 61 (Withdrawn): The medical system of claim 57, further comprising:
means for delivering a therapy to the patient according to a plurality of therapy parameter sets;
means for associating each of the determined sleep quality metric values and each of the determined activity levels with a current therapy parameter set;
means for determining a representative value of each of the at least one sleep quality metric for each of the plurality of therapy parameter sets based on the sleep quality metric values associated with the therapy parameter sets;

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

means for determining at least one activity metric value for each of the plurality of therapy parameter sets based on the activity levels associated with the therapy parameter sets; and
means for presenting a list of the therapy parameter sets, associated representative sleep quality metric values, and associated activity metric values.

Claim 62 (Withdrawn): A medical system comprising:

an implantable medical device that delivers a therapy to a patient based on a plurality of therapy parameter sets, monitors a plurality of physiological parameters of the patient including at least one parameter indicative of patient physical activity, determines when the patient is attempting to sleep, determines values of at least one metric that is indicative of sleep quality based on at least one of the physiological parameters and a determination that the patient is attempting to sleep, periodically determines an activity level of the patient based on at least one of the physiological parameters and a determination that the patient is not attempting to sleep, associates each determined sleep quality metric value and each determined activity level with a current therapy parameter set, determines a representative value of each of the at least one sleep quality metrics for each of the plurality of therapy parameter sets based on the sleep quality metric values associated with the therapy parameter set, and determines at least one activity metric value for each of the plurality of therapy parameter sets based on the activity levels associated with the therapy parameter set; and

an external programming device including a display that receives information identifying the plurality of therapy parameter sets and the sleep quality metric values and activity metric values associated with the therapy parameter sets from the implantable medical device, and presents a list of the therapy parameter sets and the associated sleep quality metric values and activity metric values to a user.

Claim 63 (Withdrawn): The medical system of claim 62, wherein the programming device includes a user interface, receives a selection of one of the sleep quality metrics and activity metrics from a user via the user interface, and orders the list of therapy parameter sets according to the associated sleep quality metric values.

Application Number 10/825,955

Amendment response to Office Action mailed July 20, 2006

Claim 64 (Withdrawn): The medical system of claim 62, wherein the implantable medical device comprises at least one of an implantable neurostimulator and an implantable drug pump.

Claim 65 (Withdrawn): A computer-readable medium comprising instructions that cause a programmable processor to:

monitor a plurality of physiological parameters of a patient, wherein the plurality of physiological parameters includes at least one parameter indicative of patient physical activity; determine when the patient is attempting to sleep;

determine values of at least one metric that is indicative of sleep quality based on at least one of the physiological parameters and a determination that the patient is attempting to sleep;

periodically determine an activity level of the patient based on at least one of the physiological parameters and a determination that the patient is not attempting to sleep; and determines a value of at least one activity metric based on the determined activity levels.

Claim 66 (Withdrawn): The medium of claim 65, wherein the instructions that cause the processor to determine when the patient is attempting to sleep comprise instructions that cause the processor to receive an indication from the patient that the patient is attempting to sleep.

Claim 67 (Withdrawn): The medium of claim 65, wherein the instructions that cause the processor to monitor a plurality of physiological parameters comprise instructions that cause the processor to monitor at least one signal that indicates posture of the patient, and the instructions that cause the processor to determine when the patient is attempting to sleep comprise instructions that cause the processor to determine when the patient is recumbent.

Claim 68 (Withdrawn): The medium of claim 65, wherein the instructions that cause the processor to determine when the patient is attempting to sleep comprise instructions that cause the processor to determine when the patient is attempting to sleep based on a physical activity level of the patient.